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Optical Synthetic Spectra of Elliptical Galaxies

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We present the first results from our population synthesis models of elliptical galaxies. Here, we concentrate upon the optical region of the integrated spectrum (3000–7000 Å). A companion paper in this volume describes the models more fully and presents a discussion of the near-infrared (0.7–3 μm).

Figure 1 compares our 16 Gyr, [Fe/H]=0.0 model spectrum to Kennicutt's (1992) spectrum of the E1/S0 galaxy NGC 4472. Since Kennicutt warns that his spectrophotometry is only accurate to ∼10% over the breadth of the wavelength region shown, the similarities between the two spectra are encouraging.

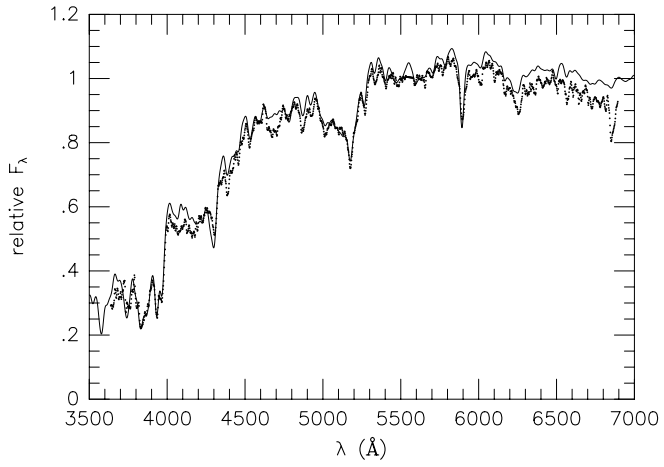

Figure 1. A comparison of the spectrum of NGC 4472 (Kennicutt 1992; solid points) to our synthetic spectrum for a 16 Gyr, [Fe/H]=0.0 stellar population (solid line). The spectra are normalized at 5500 Å, and the synthetic spectrum has been convolved and rebinned to the resolution of Kennicutt's data.

Figure 2 shows how the optical colors measured from our synthetic spectra vary with the age and metallicity of the stellar population. Worthey (1994; hereafter W94) model colors and some photometry of E/S0 galaxies are also shown. Our models are more consistent with the color-color relations of E galaxies being caused by variations in metallicity rather than age changes. Our 16 Gyr models infer that the reddest ellipticals have [Fe/H]∼+0.25. W94 predicts a lower metallicity because his stellar continua are ∼0.06 mag too red in $B-V$.

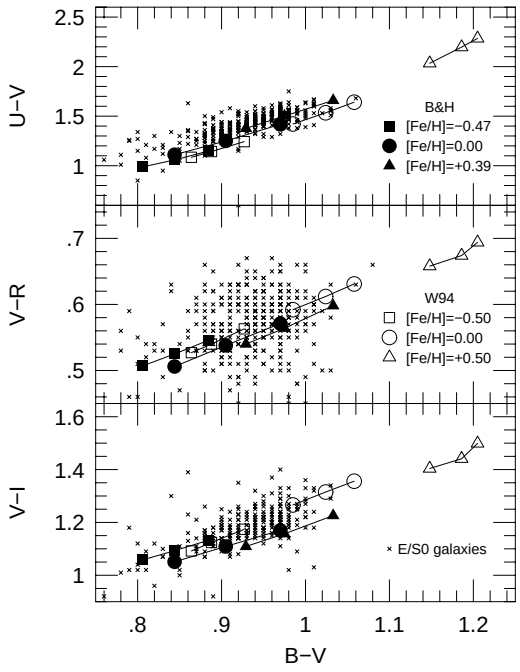

Figure 2. The optical colors measured from our synthetic spectra are compared to the models of W94 and photometry of E/S0 galaxies (Prugniel & Simien 1996). From blue to red at each metallicity, our 6, 10 and 16 Gyr models and the 8, 12 and 17 Gyr models of W94 are compared.

Our model Lick indices (not shown) follow the galaxy trends about as well as the W94 models. However, the age/metallicity associated with a specific color or index in the two sets of models usually differ. While we do not have the problem that W94 encountered in matching the TiO_1, TiO_2 relation of elliptical galaxies, our models do not exhibit the same CN_1, CN_2 and Mg_2, Mg b trends as the W94 models, which closely follow the galaxy measurements. Since CN_1 and CN_2 are defined by the same CN bandpass, the difference must lie in the continuum bands used to measure the indices (perhaps in the strength of Hδ). We suspect that some factor other than Mg abundance is causing the Mg_2, Mg b discrepancy (see Tripicco & Bell 1995). Surprisingly, neither set of models is able to simultaneously match the Mg_2 and Mg_1 indices of E galaxies.

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References

Kennicutt, R.C., Jr. 1992, ApJS, 79, 255.

Prugniel, P. & Simien, F. 1996, A&A, 309, 749.

Tripicco, M.J. & Bell, R.A. 1995, AJ, 110, 3035.

Worthey, G. 1994, ApJS, 95, 107. (W94)